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Assessment of Groundwater Quality of various Areas of Aurangabad City, Maharashtra, India

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ABSTRACT: Aurangabad city is historic and industrially developed and it has many resources, because urbanization is taking place at rapid rate of pressure over surface water resources like, lakes and rivers, man-made water reservoir and other water bodies hence alternative of the water use is groundwater. But due to human negligence Industries effluents, solid waste and disposal of sewage etc. are contaminating groundwater. The present investigation reveals that the groundwater quality from selected locations that maximum samples have high values in Electrical conductivity, dissolved oxygen, Sodium, total Alkalinity, Total Hardness and these values exceeding the permissible limit for drinking purpose as per World Health Organization Bureau of Indian Standards and Indian Council of Medical Research guidelines. The study indicates that for domestically used water is so much polluted, and may be the probable reasons for the pollution are municipal sewage, man-made activities and the lack of means to protect groundwater wells.

KEYWORDS: Aurangabad City, Groundwater, Physicochemical parameters, Water quality, WHO.

I. INTRODUCTION

Surface water is the main resource for drinking and domestic purposes, its scarcity because of industrial development and population growth; it makes people by forcing to use groundwater for the portable and domestic uses in urban areas in Aurangabad. Therefore the establishment of numbers illegal wells and the lack of means to protect groundwater wells from different pollutants lead to reduce of groundwater storage and its pollution by pollutants and contaminations which coming from various sources like industrial effluent and sewage water of household before use groundwater we have to assess its quality to decide that the water suitable for drinking and domestic uses, so we have been selected random samples from Aurangabad city to study Physicochemical parameters and comparing the obtained values with the standard value on the basis of WHO, BIS and ICMR guidelines.

In this investigation the TDS concentration of samples was within permissible at maximum of samples as showed in the table below on the basis of Davis and Dewiest classification where they classified water depend on TDS concentration into fresh water its TDS concentration is 0-1000 mg/l and it represents 64.3% of selected samples of this study, Brackish water its TDS is 1001-10000mg/l represents 35.7% of selected sample, Salty water TDS concentration is 10001-100000 mg/l and Brine water its TDS concentration is >100000 mg/l.

II. STUDY AREA

Aurangabad District is located mainly in Godavari Basin and its some part towards North West of Tapi River Basin. This District's general down level is towards the South East and North West part comes in Purna-Godavari river basin.

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Vol. 6, Issue 11, November 2017

The Aurangabad district's North Longitude (Degree) is 19 and 20 and East Longitude (Degree) is 74 to 76. Area is 10.100 Sq. km. urban areas represent 141.1Sq. km. Population of Aurangabad city depend on census of India 2011 was 1.171.330 and census of 2001 was 902.179 with population growth percentage 29.8%.

Aurangabad urban area has only limited groundwater resources, both in terms of overall resource availability and water well yield potential (Stephen Foster and Yugandhar Mandavkar, 2008).

Ground water become polluted due to industrial activities and human uses and the pollutants discharge into ground water and mix with it therefore the characteristics and properties of water change and this water become unsuitable for drinking (Bishnoi, and Malik (2008).

SAMPLING LOCATIONS FOR THE STUDY

S1: Chhavni weekly market, Aurangabad.

S2: Shantipura, Aurangabad.

S3: Bhuiweda near house No. 215-792, Aurangabad.

S4: Tulja Bhavanimandir Khadkeshwar, Aurangabad.

S5: Radhakrushna Colony, Samartharcadegate, Aurangabad.

S6: Harsul lake (surface water), Aurangabad.

S7: Samarth mandir mayor nagar, Aurangabad.

S8: Udhavraopatil high school Himayat Bugh, Aurangabad.

S9: Labor colony Harsh Nagar, Aurangabad.

S10: Saba Apartment, Shaha Bazar Bhoiwada (Mahadevmandir), Aurangabad.

S11: Shaha Bazar Bhoiwada (near electric pole), Aurangabad.

S12: Bahuchara Devidattamandir chouraha (Maratha High school), Aurangabad.

S13: Ambedkar hall Paithan gate, Aurangabad.

S14: Ganpati Mandir Ganesh Nagar Sataraparisar, Aurangabad.

A. SAMPLE COLLECTION

In this study, Total fourteen samples were collected randomly from locations in Aurangabad city which is the study area, in last November 2013 (winter season) and we followed all the recommendations for sampling and preservation for samples (NEERI, 2007; APHA., 2000), for sampling, bore well samples taken by a pump that found in citizens buildings and from public bore well that found in near the houses to flow the water for at least five minutes. The required volumes of water were collected in plastic container directly.

B. METHODOLOGY

Materials and methods for chemical and physical analysis of water samples accredited in this study work are according to APHA (2000), WHO (1996 Manual),

Temperature (T) has taken by the mercury thermometer (APHA, 2000). The value of pH was measured as soon as collection the samples at the locations by portable pH meter operated by battery and by use ready buffer solution to calibrate pH meter and other parameters were analyzed in the laboratory within 24 hours to 8 days. Electrical conductivity (EC) measurement (Saxena, 1987) gives rapid and practical estimate of the variance in the dissolved mineral contents of a water body (NEERI, 2007). It is measured with the help of a conductivity meter having a conductance cell containing electrodes of platinum coated with carbon.

Dissolved Oxygen (DO) analyzed by winkler azide modification titrimetric (APHA, 2000; Operation Manual, 2001); Chemical Oxygen Demand (COD) analyzed by the open reflux method (NEERI, 2007) Chloride content in this study was assessed by Argentometric titration (Operation Manual, 2001), where silver nitrate reacts with chloride to form very

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Vol. 6, Issue 11, November 2017

slightly soluble white precipitate of AgCl. Calcium Ca and sodium never analyzed by Flame Emission Photometric Method.

Sulphate SO_4 ions determined by Nephelometry (Operation Manual, 2001) or called Turbidimetric method, by using nephelometer/turbidimeter. Analysis of phosphate ions PO_4 carried out by Stannous chloride method (NEERI, 2007). Total dissolved solid (TDS) content determined as the residue left after evaporation of the filtered sample, TDS also calculated by summation of total suspended solid TSS with total solid (TS). Total alkalinity (TA) can be estimated by titrating the sample with a strong acid (HCL or H_2SO_4) (APHA 2000). Total hardness (TH) is determined by the EDTA titration method in alkaline condition (APHA (2000)), its caused by the calcium and magnesium ions in water. Nitrate NO_3 ions determined by the phenol disulfonis acid method where nitrate reacts with the phenol disulfonis acid to form a nitro-derivative which in alkaline medium develops a yellow color (APHA (2000)). The chemicals materials were prepared with AR grade and Equivalent grade. Glassware and instruments that used for water quality parameter like flame photometer and spectrophotometer were calibrated at room temperature.

III. RESULTS AND DISCUSSION

The underground water samples were analyzed for physicochemical characteristics. In the table (1) the obtained values are for fourteen selected samples of groundwater that collected in November 2013 (winter season). And in this season the temperature is low compared with summer season leads to that rise in temperature of water results in increasing of the chemical reactions in water, decreases the solubility of gases and increasing the taste and odors.

Table (1) Values of samples of groundwater quality parameters in Aurangabad city of Maharashtra (Winter Season, Nov. 2013)

Location	Temp	pH	EC	DO	COD	Cl^{-3}	Ca^{2+}	Na^{+}	So_4^{2-}	PO_4	TDS	TA	TH	NO_3^{-}
L1	27.6	7.5	759	5.3	125	121	235	89	16.5	0.14	455	346	359	20.2
L2	25.8	7.1	2301	5.1	143	784	141	101	47	0.12	1365	349	1102	44.5
L3	25.2	6.8	1223	5.3	122	112	370	59	54.3	0.15	793	293	658	16.6
L4	26.3	6.9	4522	6.5	131	211	216	274	25.5	0.15	2911	291	921	16.8
L5	26.8	6.9	3617	4.3	156	151	356	187	36	0.15	2307	394	1076	43.1
L6	26.2	7.1	773	4.6	113	155	100	39	24.5	0.14	397	274	379	30.7
L7	27.3	6	1410	7.3	129	976	138	128	35	0.14	988	302	994	32.7
L8	26.4	6.1	853	7	92	238	180	79	23	0.14	534	332	418	39.1
L9	26.2	6.2	4513	6.4	121	573	153	131	76	0.12	2778	370	1681	26.4
L10	26.8	6.8	1123	5.8	150	1317	171	61	26.5	0.17	721	349	451	22.3
L11	25.3	6.8	1811	5.2	152	239	203	83	31.5	0.14	986	238	879	28.7
L12	27.1	6.9	1421	6.5	120	420	173	149	54.5	0.15	897	312	593	42.6

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 6, Issue 11, November 2017

L13	26.8	6.6	139 3	6.4	116	247	136	69	33	0.1 4	791	236	688	27.6
L14	25.3	7	241 0	7.6	123	1211	159	181	32.5	0.1 3	147 3	251	904	28.8

[All parameters are given in mg/l, excluding E.C. $\mu\text{mhos/cm}$, Temperature (T) $^{\circ}\text{C}$ and pH.]

Table No. 2 Standard Limits of different institutions

Parameters	water Quality Standards			
	ICMR	BIS	WHO	Units
Temp				$^{\circ}\text{C}$
pH	6.5- 8.5	6.5- 9.0	6.5- 8.5	
EC	300			$\mu\text{mhos/cm}$
DO	5			mg/l
COD			10	mg/l
Cl^{3-}		1000	200	mg/l
Ca^{2+}			200	mg/l
Na^{+}	50	50	50	mg/l
So_4^{2-}				
PO_4^{-}				
TDS	<1500	1500	1500	mg/l
TA				mg/l
TH	300	300	300	mg/l
NO_3^{-}		400	200	mg/l

3.1. Temperature

In this study temperature T of selected groundwater samples in the range from 25.2 $^{\circ}\text{C}$ to 27.6 $^{\circ}\text{C}$ at all sampling locations.

At higher temperature oxygen and other gasses solubility is decreasing and the taste of water will be tasteless, therefore the metabolic activity of living organism in water increase this reactions happen in summer season, but in winter with low temperature the metabolic of organisms will be reduced and solubility of oxygen increases. Temperature effect on Dissolved oxygen and BOD (Kasthuri and et Al 2005).Al 2005).

3.2. pH

The obtained pH value of groundwater was in the range from 5.96 to 7.47, within the permissible limit 6.5 to 8.5 (WHO, 1996) and 6.5 to 9.0 as per (BIS, 1991) and this indicating low alkalinity of water and the chemical and biological reactions depend on the pH of water system in other word acidity or alkalinity of water system. Because of presence of carbonate and bicarbonate in water this leads to most of waters are slightly alkaline, also most of living organisms can survive in narrow pH value from slightly

alkaline to slightly acidic, so pH is very important for plant and animal.

3.3. Electrical Conductivity (EC)

in this study in range from 759 to 4522 $\mu\text{mhos/cm}$, so we can observe that all the groundwater samples above the permissible limit 300 $\mu\text{mhos/cm}$ as per of WHO and BIS.

Electrical conductivity is a measure of water capacity to transfer electrical current it determines the amount of total dissolved salt. Large measure of EC means presence of soluble ions which leads to presence of metals and chlorides.

3.4. Dissolved Oxygen (DO)

Generally not applied to unpolluted water, it is applied mainly for determination the DO for polluted waters and Industrial effluents (Hassan and Pande, 1993), in this study Dissolved Oxygen in the range from 4.3 to 7.6 mg/l, all the samples above the permissible limit is 5.0 mg/l as per BIS except L5 and L6. DO represent important parameter and it is indicator of water quality where DO concentration controls and arranges of distribution of animal and plants those living in the water environment. DO have high value in monsoon season due to low of temperature and at high temperature DO value decreases and these threats the health of human.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 11, November 2017

3.5. Chemical Oxygen Demand (COD)

Chemical oxygen demand COD is oxygen required for oxidation of organic and inorganic matter in the water. COD is method the organic load of water. In this study COD values varies from 92 to 156 mg/l, the higher values of COD means there is high organic pollution, and in this study some samples have higher COD values. The high values of COD due to industrial and human activities where the contaminates and waste discharge on earth surface and gradually pass into ground and mix with groundwater.

3.6. Chloride (Cl)

Chloride values in this study are found in the range from 112 to 2113 and permissible limit is 1000 mg/l as per BIS, location L4 and L5 are polluted with chloride, high chloride content in drinking water result in high blood pressure in human and salty taste of water (WHO, 1996). The high value of chloride means the water is not suitable for drinking and other domestic purpose and this water is saline water needs special filtration for purification.

3.7. Calcium (Ca)

Calcium concentration in this study found to be ranging from 100 mg/l to 370 mg/l, so the locations L1, L3, L4, L5 and L11 have calcium content above permissible value is 200 mg/l and have hardness (Banejad and Abdosalehi, 2009) The recommended quantity of Ca daily taken for adults ranges from 700 to 1000 mg (Scientific Committee for Food, 1993; Committee on Dietary Reference Intake, 1997). The high level of Ca leads to kidney disease because of accumulation Ca molecules in kidney forms stones and threat the urine system.

3.8. Sodium (Na)

For sodium contents found to be ranging from 39 to 274 mg/l, permissible value must be 50 mg/l or less, but in this study sodium contents in all samples above 50 mg/l this means water unsuitable for portable purpose except L6 as per BIS and WHO. And the taste of water which has high level content of Na undesirable (salty) and Na react with Cl to form NaCl and change the taste of water.

3.9. Sulphate ions SO_4^{2-}

In this investigation, concentrations were in range from 25.3 mg/l to 27.6 mg/l and all samples are below permissible limit 200 mg/l. Phosphate ions PO_4^- contents in this study are ranging from 0.121 to 0.171 mg/l they are within the permissible limit which is 0.5 mg/l as per WHO.

3.10. Total Dissolved Solids (TDS)

Total dissolved solids TDS of ground water of selected samples of this work are in the range from 397 mg/l to 2911 mg/l, permissible value of TDS in drinking water as per WHO and BIS is 1500 mg/l, this leads to all the samples suitable for drinking purpose except L4, L5 and L9 and the variation in results and high content of TDS in some of the sample due to weathering of rock and soil (Nirmal Kumar, et al 2003).

3.11. Total Alkaline (TA)

Total Alkaline TA concentration in this investigation in the range from 236 to 394 mg/l, permissible limit is 200 mg/l mentioned in BIS, so all samples are above permissible limit.

3.12. Total Hardness (TH)

Total Hardness TH is range from 359 to 1681 mg/l, all samples of this study are hard because they are above permissible limit 600 mg/l as per BIS and unsuitable for drinking purpose and domestic, and this water is toxic and harmful for health (Peter et al., 1998), except samples L1, L6, L8, L10 and L12. Finally nitrate ions NO_3^- contents ranging from 16.6 mg/l to 44.5 mg/l, all samples are well and within the permissible limit 100 mg/l as per BIS.

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Vol. 6, Issue 11, November 2017

3.0.1. STATISTICAL ANALYSIS

Table No3. Correlation coefficient of different physico-chemical parameters.

	Temp	pH	EC	DO	COD	Cl ³⁻	Ca ²⁺	Na ⁺	So ⁴²⁻	PO ⁴⁻	TDS	TA	TH	NO ³⁻
Temp	1.00													
pH	-0.05	1.00												
EC	-0.18	-0.11	1.00											
DO	0.07	-0.55	0.05	1.00										
COD	-0.07	0.32	0.31	-0.48	1.00									
Cl ³⁻	-0.03	-0.18	0.00	0.47	0.25	1.00								
Ca ²⁺	-0.14	0.20	0.17	-0.41	0.31	-0.43	1.00							
Na ⁺	0.04	0.03	0.77	0.31	0.21	0.06	0.18	1.00						
So ⁴²⁻	-0.26	-0.31	0.42	0.06	0.01	0.08	0.08	0.06	1.00					
PO ⁴⁻	0.30	0.11	-0.27	-0.15	0.25	-0.01	0.37	-0.02	-0.38	1.00				
TDS	-0.14	-0.14	1.00	0.08	0.31	0.02	0.19	0.80	0.41	0.23	1.00			
TA	0.40	-0.03	0.29	-0.29	0.22	0.05	0.30	0.12	0.25	0.03	0.3	1.00		
TH	-0.25	-0.36	0.82	0.12	0.31	0.20	0.01	0.45	0.69	0.56	0.8	0.2	1.00	
NO ³⁻	0.14	-0.14	-0.04	-0.08	0.04	0.07	0.19	0.02	0.15	0.28	0.0	0.3	0.1	1.00

IV. CONCLUSIONS

Selected groundwater samples in this study are generally harmful to human beings and they can use in domestic purpose and sometimes in portable purpose depend on the ions contents in water, which are above the permissible limit as per WHO, BIS guidelines. The main reasons behind this pollution may be because industrial human and mining activities and also due to weathering and erosion of bed rocks.

From the obtained results we can conclude that groundwater is polluted and its impacts on human health will be severe and lead to many diseases for human and some samples not suitable for domestic purpose like washing due to high content of hardness as Ca and Mg ions, and the high values indicates that the extent pollution occurred due to the industrial, mining and human activities so this water should not be used in drinking purpose and domestic use. There are various ways as ground water is contaminated such as use of fertilizer in farming seepage from effluent bearing water body.

The polluted water at inconvenient place increases the entrance of contaminated harmful contents to the ground water. Most of the industries discharge their effluent without proper treatment into nearby open pits or pass them through unlined channels, resulting in the contamination of ground water, And these effluents cause pollution to ground water therefore the industries must be established away from ground water resources and its effluent should be treated and reuse again in same activity.

International Journal of Innovative Research in Science, Engineering and Technology

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